CLAIMS:

1. A method of acquiring and processing Magnetic Resonance Image (MRI) data from Nuclear Magnetic Resonance signals generated by an object within a magnetic field having a predetermined spatial gradient, for use in reconstructing an image representing said object, the method comprising the steps of:

acquiring a first set of first image data items using a first value of said predetermined spatial gradient for use in constructing a first image of said object;

acquiring a second set of second image data items using a second value of said predetermined spatial gradient which differs from said first value thereof for use in constructing a second image of said object wherein second image data items of said second set are acquired before acquisition of said first set is complete;

generating third image data items according to first image data items, second image data items and the ratio of said different first and second values of said predetermined spatial gradient.

2. A method according to Claim 1 wherein said second image data items of said second set acquired before acquisition of said first set is complete are acquired from points in Fourier-Space which coincide with those

points in Fourier-Space from which first image data items of said first set are acquired.

3. A method according to Claim 2 in which acquiring said first set of first image data items and said second set of second image data items includes the steps of:

(a) acquiring first image data items from a selected set of points in Fourier-Space; and

(b) acquiring second image data items from said selected set of points in Fourier-Space; and

(c) selecting a new set of points in Fourier-Space and repeating steps (a) and (b) in respect of said new selected set of points until acquisition of said first set is complete.

4. A method according to Claim 3 in which said selected set of points in steps (a) and (c) each forms a respective line of points in Fourier-Space wherein a set of points selected in step (c) forms a line of points being substantially parallel to a line of points formed by the selected set of points employed in preceding steps (a) and (b).

5. A method according to any preceding claim wherein the ratio of said different values of said predetermined spatial gradient is a constant value.

6. A method according to any preceding claim wherein the third image data items include pixel values of an image representing said object and are generated such that the position (x_3) of an image pixel in an image constructed according to the third data items is related to the positions (x_1 and x_2) of an image pixel in an image constructed according to the first and second data items respectively via the equation:

$$x_3 = \frac{\alpha x_1 - x_2}{\alpha - 1}$$

where α is the value of said ratio of said different values of said predetermined spatial gradient.

7. A method according to claim 6 wherein pixel intensity values (i_3) of an image pixel at position x_3 in an image constructed according to the third data items is related to the pixel intensity values (i_1 and i_2) of an image pixel in an image constructed according to the first and second data items respectively at positions x_1 and x_2 via the equation:

$$i_3 = (1-\alpha)\frac{i_1 \cdot i_2}{i_1 - \alpha \cdot i_2}$$

where α is the value of said ratio of said different values of said predetermined spatial gradient.

8. A method according to any of Claims 1 to 7 wherein the ratio of said different values of said predetermined spatial gradient is substantially equal to -1 (minus one).

9. A method according to any preceding claim including the steps of:

generating first real-space image data items from said first image data items, and second real-space image data items from said second image data items;

defining a first image boundary corresponding to the periphery of an image feature within the image frame of an image constructed according to said first real-space image data items;

defining a second image boundary corresponding to the periphery of said image feature within the image frame of an image constructed according to said second real-space image data items;

defining a third image boundary according to said first boundary and said second boundary; and,

segmenting said first real-space image data items according to said first image boundary;

segmenting said second real-space image data items according to said third image boundary.

10. A method according to Claim 9 wherein said first and said second real-space image data items are each segmented such that: data items outside said first and third image boundary are discarded respectively; and, data items inside said first and third image boundary are retained respectively.

11. A method according to Claim 9 or Claim 10 wherein the third image boundary is defined according to an average of the difference between the first image boundary and the second image boundary.

12. A method according to Claim 11 wherein the third image boundary is defined by one of the first image boundary and the second image boundary modified according to an average of the difference between the first image boundary and the second image boundary.

13. A method according to Claim 11 or 12 wherein the first image boundary is defined by a first image boundary vector and the second image boundary is defined by a second image boundary vector and said difference between said first image boundary and said second image boundary is a difference vector being the difference between said first image boundary vector and said second image boundary vector.

14. A method according to Claim 13 wherein the third image boundary is defined by a third image boundary vector being one of the first image boundary vector and the second image boundary vector to which is added an averaged-difference vector being an average of said difference vector.

15. A method according to Claim 14 wherein the value of each element of said averaged-difference vector is determined as a weighted average of the values of:

a corresponding element of said difference vector; and,

a predetermined number of elements of said difference vector which neighbour said corresponding element.

16. A method according to any preceding claim including the steps of:

generating first real-space image data items from said first image data items, and second real-space image data items from said second image data items;

(a) comparing first real-space data items with second real-space data items;

(b) estimating whether or not data items so compared correspond with the same feature of the imaged object; and if not,

(c) iteratively repeating steps (a) and (b) in respect of real-space data items at least one of which differs from any of those compared in the previous iteration of step (a).

17. A method according to any preceding claim comprising the steps of:

generating first real-space image data items from said first image data items, and second real-space image data items from said second image data items;

(i) selecting a first set of data items from said first real-space image data items;

(ii) selecting a second set of data items from said second real-space image data items;

(iii) comparing data items from said first set with data items from said second set;

(iv) defining a measure of similarity between data items so compared;

(v) estimating according to said measure of similarity whether or not said real-space data items so compared correspond with the same feature of the imaged object; and if not,

(vi) iteratively repeating steps (ii) to (v) in which at least one data item of said first set is compared to a data item of said second set with which it was not compared in the previous iteration of step (iii).

18. A method according to Claim 17 wherein said first set and said second set of data items comprises image pixel values corresponding to a group of pixels positioned within an image constructed according to said first and said second real-space image data items respectively whereby the pixel position of each element of the group neighbours the pixel position of another element of the group.

19. A method according to Claim 18 in which step (ii) includes selecting a subset of one or more data items from within said second set defining a subgroup of pixel values whereby the pixel position of each element of the subgroup neighbours the pixel position of another element of the subgroup when the subgroup comprises a plurality of elements, and in which step (iii) includes comparing pixel values of the first set with pixel values of the second set in which the pixel position of at least one element of said subset is displaced relative to the pixel position of the same element during the previous iteration of step (iii).

20. A method according to Claim 19 in which when the estimation according to step (v) is affirmative steps (ii) to (v) and (vi) are performed in respect only of elements within the subset in respect of which the affirmative estimation according to step (v) was obtained.

21. A method according to Claim 19 or 20 wherein each subset comprises a predetermined proportion of the total number of elements from within the set from which they are selected.

22. A method according to Claim 21 wherein the predetermined proportion is one half (1/2).

23. A method of reconstructing nuclear Magnetic Resonance images (MRI) or other images using the method of any of preceding Claims 1 to 22.

24. Apparatus for acquiring and processing Magnetic Resonance Image (MRI) data from Nuclear Magnetic Resonance signals generated by an object within a magnetic field having a predetermined spatial gradient, for use in reconstructing an image representing said object, the apparatus comprising:

image acquisition means for acquiring a first set of first image data items using a first value of said predetermined spatial gradient for use in constructing a first image of said object, and for acquiring a second set of second image data items using a second value of said predetermined spatial gradient which differs from said first value thereof for use in constructing a second image of said object, wherein said image acquisition means is arranged to acquire second image data items of said second set before acquisition of said first set is complete;

gradient control means for changing the value of said predetermined spatial gradient;

image processing means for generating third image data items according to first image data items, second image data items and the ratio of said different first and second values of said predetermined spatial gradient.

25. Apparatus according to Claim 24 wherein said image data acquisition means is arranged to acquire second image data items of said second set before acquisition of said first set is complete from points in Fourier-Space which coincide with those points in Fourier-Space from which first image data items of said first set are acquired.

26. Apparatus according to Claim 25 in which said image data acquisition means is arranged to acquire said first set of first image data items and said second set of second image data items by:

(a) acquiring first image data items from a selected set of points in Fourier-Space; and

(b) acquiring second image data items from said selected set of points in Fourier-Space; and

(c) selecting a new set of points in Fourier-Space and repeating steps (a) and (b) in respect of said new selected set of points until acquisition of said first set is complete.

27. Apparatus according to Claim 26 in which said selected set of points in steps (a) and (c) each forms a respective line of points in Fourier-Space wherein a set of points selected in step (c) forms a line of points being substantially parallel to a line of points formed by the selected set of points employed in preceding steps (a) and (b).

28. Apparatus according to any of claims 24 to 27 wherein said gradient control means is arranged to change the value of said predetermined spatial gradient such that the ratio of said different values thereof is a constant value.

29. Apparatus according to any of preceding claims 24 to 28 wherein the third image data items include pixel values of an image representing said object and are generated such that the position (x_3) of an image pixel in an image constructed according to the third data items is related to the positions (x_1 and x_2) of an image pixel in an image constructed according to the first and second data items respectively via the equation:

$$x_3 = \frac{\alpha x_1 - x_2}{\alpha - 1}$$

where α is the value of said ratio of said different values of said predetermined spatial gradient.

30. Apparatus according to claim 29 wherein pixel intensity values (i_3) of an image pixel at position x_3 in an image constructed according to the third data items is related to the pixel intensity values (i_1 and i_2) of an image pixel in an image constructed according to the first and second data items respectively at positions x_1 and x_2 via the equation:

$$i_3 = (1-\alpha)\frac{i_1 \cdot i_2}{i_1 - \alpha \cdot i_2}$$

where α is the value of said ratio of said different values of said predetermined spatial gradient.

31. Apparatus according to any of claims 24 to 30 wherein the ratio of said different values of said predetermined spatial gradient is substantially equal to -1 (minus one).

32. Apparatus according to any of preceding claims 24 to 31 wherein said image processing means is arranged to:

generate first real-space image data items from said first image data items, and second real-space image data items from said second image data items;

define a first image boundary corresponding to the periphery of a feature within the image frame of an image constructed according to said first real-space image data items;

define a second image boundary corresponding to the periphery of said feature within the image frame of an image constructed according to said second real-space image data items;

define a third image boundary according to said first boundary and said second boundary;

segment said first real-space image data items according to said first image boundary;

segment said second real-space image data items according to said third image boundary.

33. Apparatus according to claim 32 wherein said image processing means is arranged to segment each of said first and said second real-space image data items such that: data items outside said first and third image boundary are discarded respectively; and, data items inside said first and third image boundary are retained respectively.

34. Apparatus according to any of Claims 32 to 33 wherein the third image boundary is defined according to an average of the difference between the first image boundary and the second image boundary.

35. Apparatus according to Claim 34 wherein the third image boundary is defined by one of the first image boundary and the second image boundary modified according to an average of the difference between the first image boundary and the second image boundary.

36. Apparatus according to Claim 34 or 35 wherein the first image boundary is defined by a first image boundary vector and the second image boundary is defined by a second image boundary vector and said difference between said first image boundary and said second image boundary is a difference vector being the difference between said

first image boundary vector and said second image boundary vector.

37. Apparatus according to Claim 36 wherein the third image boundary is defined by a third image boundary vector being one of the first image boundary vector and the second image boundary vector to which is added an averaged-difference vector being an average of said difference vector.

38. Apparatus according to Claim 37 wherein the value of each element of said averaged-difference vector is determined as a weighted average of the values of:

a corresponding element of said difference vector; and,

a predetermined number of elements of said difference vector which neighbour said corresponding element.

39. Apparatus according to any of preceding claims 24 to 38 wherein the image processing means is arranged to perform the steps of:

generating first real-space image data items from said first image data items, and second real-space image data items from said second image data items;

(a) comparing first real-space data items with second real-space data items;

(b) estimating whether or not data items so compared correspond with the same feature of the imaged object; and if not,

(c) iteratively repeating steps (a) and (b) in respect of real-space data items at least one of which differs from any of those compared in the previous iteration of step (a).

40. Apparatus according to any of preceding claims 24 to 39 wherein the image processing means is arranged to perform the steps of:

generating first real-space image data items from said first image data items, and second real-space image data items from said second image data items;

(i) selecting a first set of data items from said first real-space image data items;

(ii) selecting a second set of data items from said second real-space image data items;

(iii) comparing data items from said first set with data items from said second set;

(iv) defining a measure of similarity between data items so compared;

(v) estimating according to said measure of similarity whether or not said real-space data items so

compared correspond with the same feature of the imaged object; and if not,

(vi) iteratively repeating steps (ii) to (v) in which at least one data item of said first set is compared to a data item of said second set with which it was not compared in the previous iteration of step (iii).

41. Apparatus according to Claim 40 wherein said first set and said second set of data items comprises image pixel values corresponding to a group of pixels positioned within an image constructed according to said first and said second real-space image data items respectively whereby the pixel position of each element of the group neighbours the pixel position of another element of the group.

42. Apparatus according to Claim 41 in which step (ii) includes selecting a subset of one or more data items from within said second set defining a subgroup of pixel values whereby the pixel position of each element of the subgroup neighbours the pixel position of another element of the subgroup when the subgroup comprises a plurality of elements, and in which step (iii) includes comparing pixel values of the first set with pixel values of the second set in which the pixel position of at least one element of said subset is displaced relative to the pixel

position of the same element during the previous iteration of step (iii).

43. Apparatus according to Claim 42 in which when the estimation according to step (v) is affirmative steps (ii) to (v) and (vi) are performed in respect only of elements within the subset in respect of which the affirmative estimation according to step (v) was obtained.

44. Apparatus according to Claim 42 or 43 wherein each subset comprises a predetermined proportion of the total number of elements from within the set from which they are selected.

45. Apparatus according to Claim 44 wherein the predetermined proportion is one half.

46. Apparatus for reconstructing nuclear Magnetic Resonance images (MRI) or other images using the apparatus of any of preceding Claims 24 to 45.

47. A computer system for use in image reconstruction according to the method of any of preceding claims 1 to 23.

48. The use of a computer system for image acquisition and processing according to the method of any of preceding Claims 1 to 23.

49. A program for a computer comprising computer code which when executed on a computer system implements a method of any of preceding claim 1 to 23 using acquired image data.

50. A computer program product storing a program for a computer according to Claim 49.

51. An image generated using the method of any of claims 1 to 23 or using any of the apparatus of any of claims 24 to 50.

52. A Nuclear Magnetic Resonance Imaging system comprising apparatus according to any of claims 24 to 51.

53. An image generated using the nuclear Magnetic Resonance Imaging system according to Claim 52.

54. An image generated using the computer system, or computer program or computer program product according to Claim 47, Claim 49 or Claim 50.

55. A method of image acquisition and processing substantially as described in any one embodiment hereinbefore with reference to the accompanying drawings.

56. Apparatus for image acquisition and processing substantially as described in any one embodiment hereinbefore with reference to the accompanying drawings.